
# Rice mapping with polarimetric SAR Data using Sentinel-1 Toolbox

## Objectives:

How to process RADARSAT-2 polarimetric products;
Derive Polarimetric decompositions for rice identification;
Rice mapping using unsuperivised polarimetric classification and supervised wishart classification.

## Data:

The sample data used in this exercise was a subset from one RADARSAT-2 Fine quad-pol image acquired on June 27, 2012.

| | |
|---|---|
| Pass | Asending |
| Product | Single Look Complex (SLC) |
| Incidence angle mid swath | 38.89 |
| Resolution | 8.1*7.6 (R*A) |
| Location | Jiangsu, China |

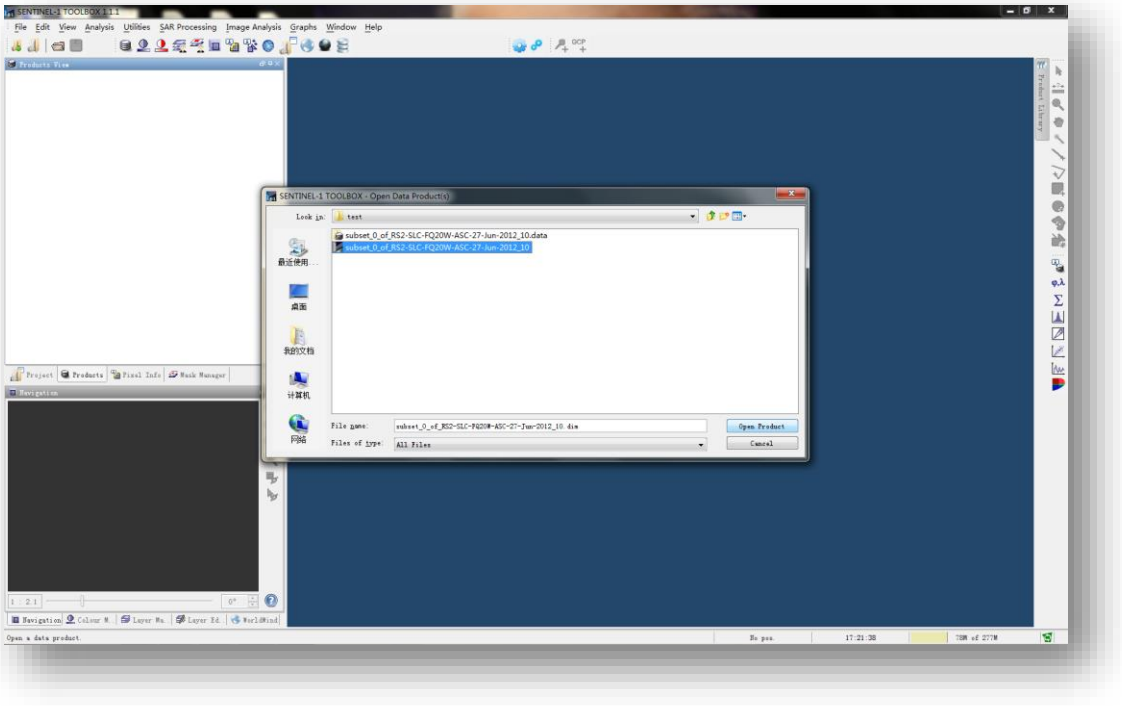
## Software:

The Sentinel-1 Toolbox and SNAP, open source software for scientific learning, research and exploitation of the large archives of ESA Sentinel and heritage missions.

# Tutorial:

## *Open the Data:*

Use the  **Open Product button** in the top toolbar and browse for the location of the sample data.

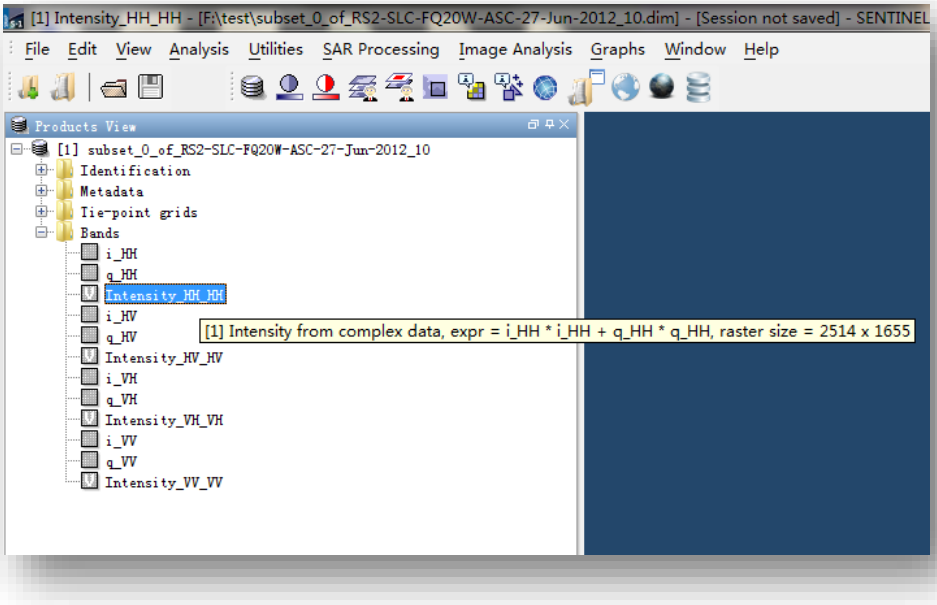



## *View the product:*

In the Products View you will see the opened product. Within the product bands you will see four polarizations:

- HH
- HV
- VH
- VV

For each polarization, there will be the complex data **i and q bands** and virtual bands for **intensity**.



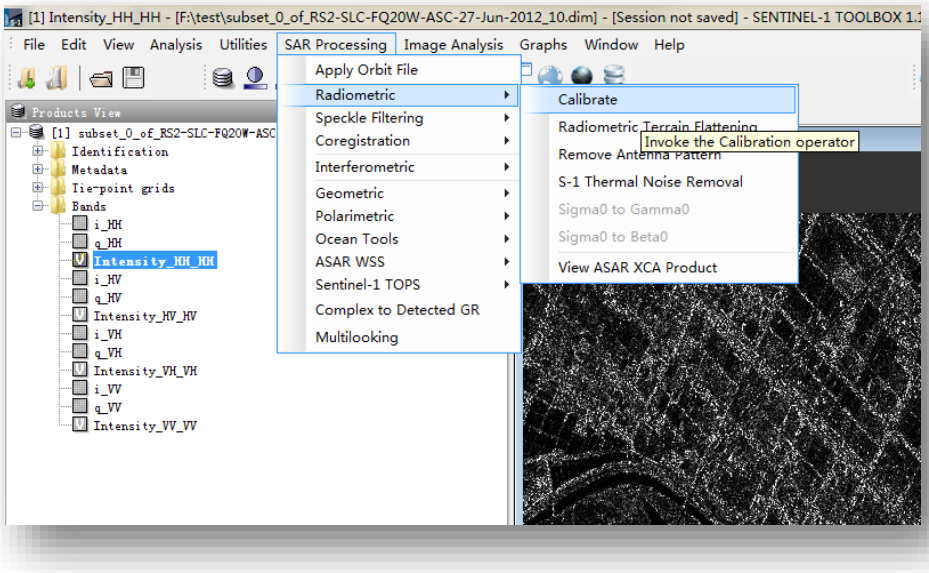

### *View a band:*

To view the HH band, double-click on the Intensity_HH band. Zoom in using the mouse wheel and pan by clicking and dragging the left mouse button.

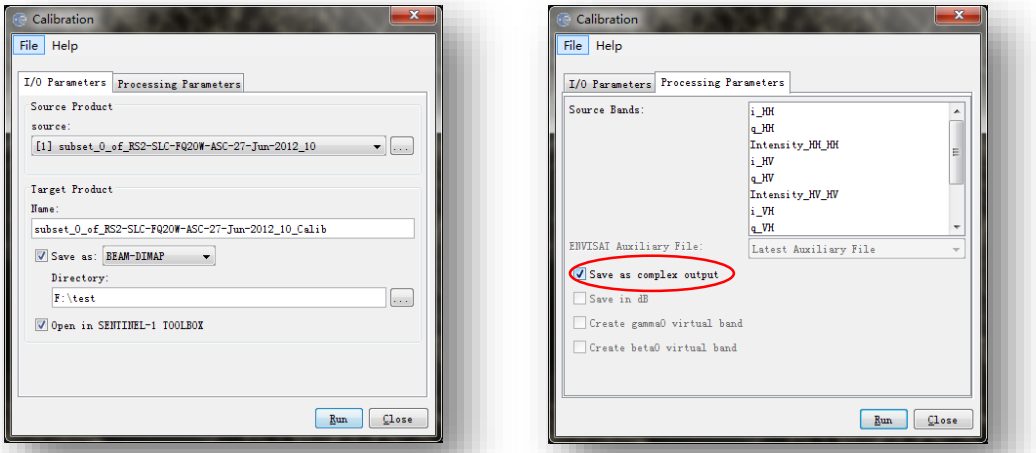

### *Calibrating the Data*

To properly work with the SAR data, the data should first be calibrated. Calibration radiometrically corrects a SAR image so that the pixel values truly represent the radar backscatter of the reflecting surface. Calibration is essential for quantitative use of SAR data.

From the **SAR Processing** menu, go to the **Radiometric** menu and select **Calibrate**.



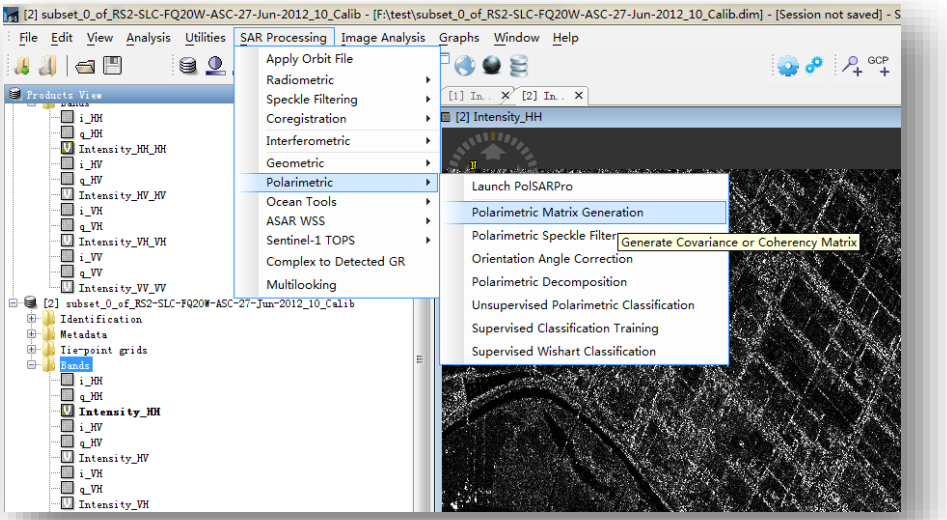

For polarimetric processing the data must be **complex**. In the Processing Parameters tab, check mark the **Save as a complex** output.



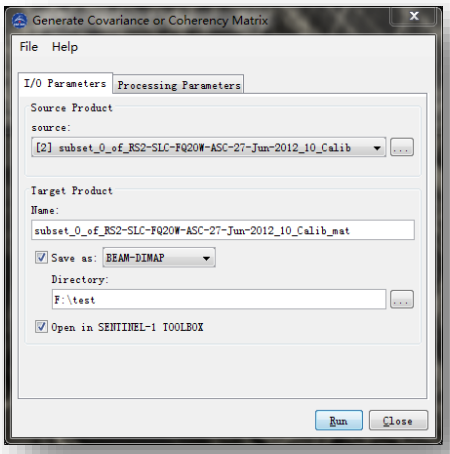

## *Polarimetric Matrix Generation*

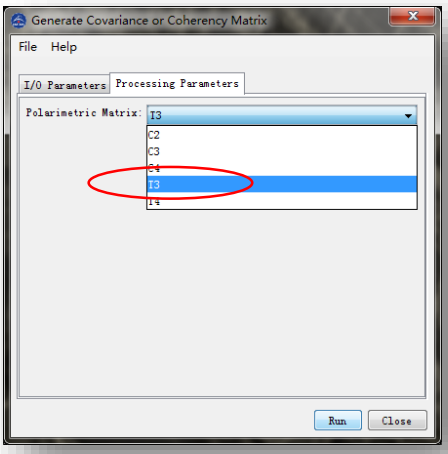
All the polarimetric tools work with either Coherency or Covariance matrices as input.

From the **SAR Processing** menu, go to the **Polarimetric** menu and select **Polarimetric Matrix Generation**.

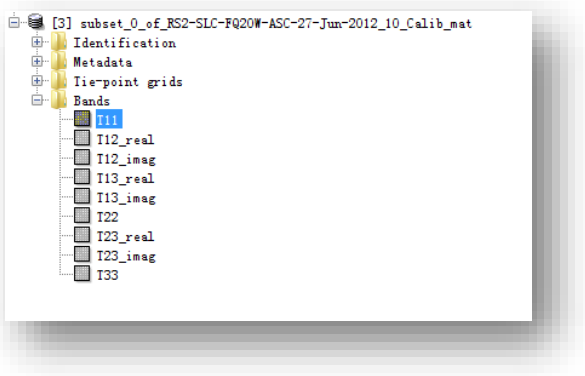



In the **Processing Parameters** tab, select a **T3** matrix to convert the Quad Pol product into a Coherency matrix T3. Press **Run** to begin processing.



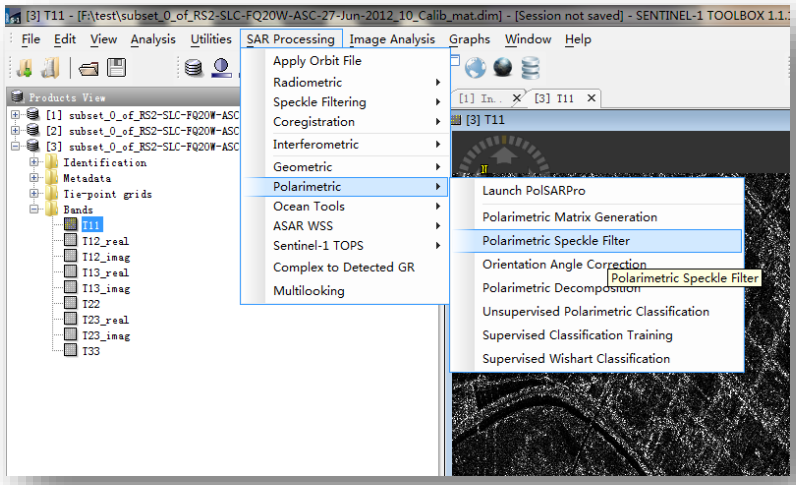

When the processing completes, a new product will be added to the Products View. You will notice the new bands produced correspond to the elements of the T3 matrix.



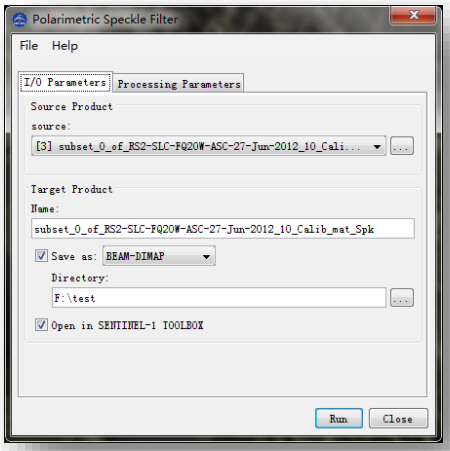

## *Polarimetric Speckle Filtering*

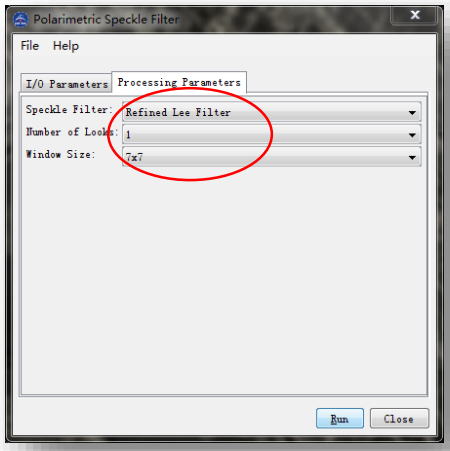
To clean up some of the speckle inherent in SAR images, you can apply a speckle filter. For full polarimetric data, speckle filters must take advantage of all bands and preserve the complex information.

Select **Polarimetric Speckle Filter** from the **Polarimetric** menu.




In the **Processing Parameters** tab, select the **Refined Lee** speckle filter, window size **7×7**. Press **Run** to begin processing.



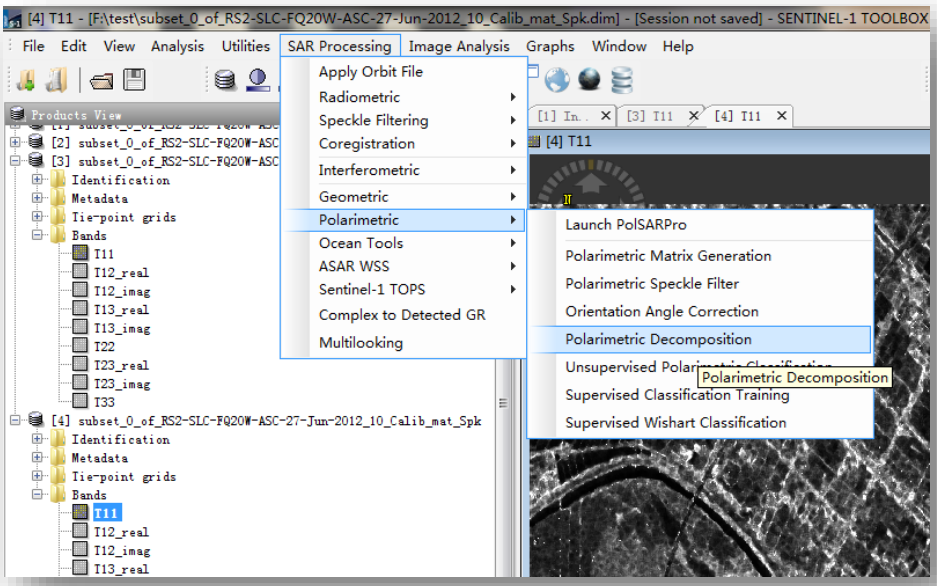




Open the T11 band in both the T3 product and in new speckle filtered T3 product to compare before and after images. The resulting image will have less speckle but also appear more blurred.

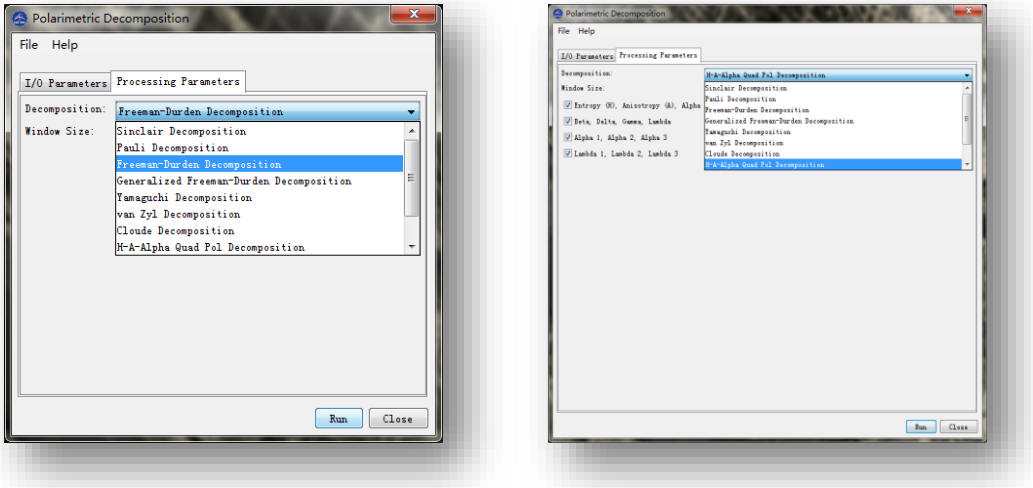

### *Polarimetric Decompositions*

Polarimetric decompositions allow the separation of different scattering contributions and can be used to extract information about the scattering process.

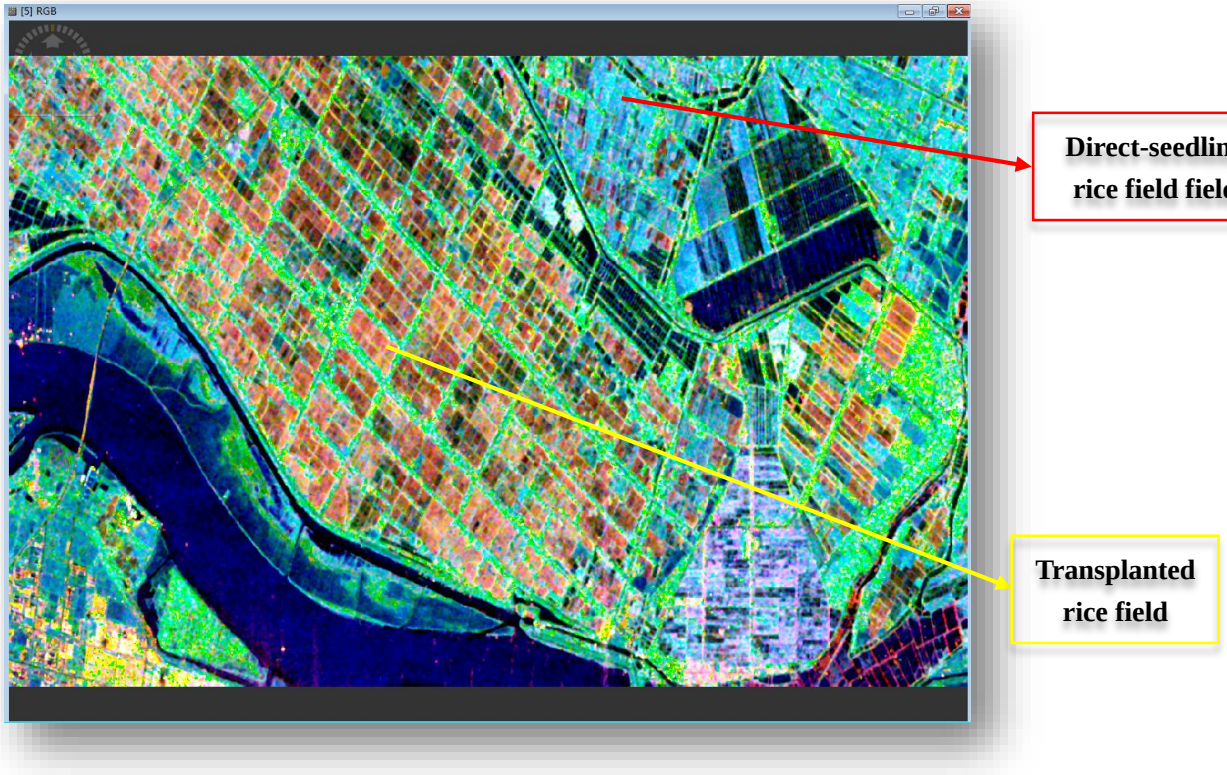
From the **SAR Processing** menu, go to the **Polarimetric** menu and select **Polarimetric Decomposition**.



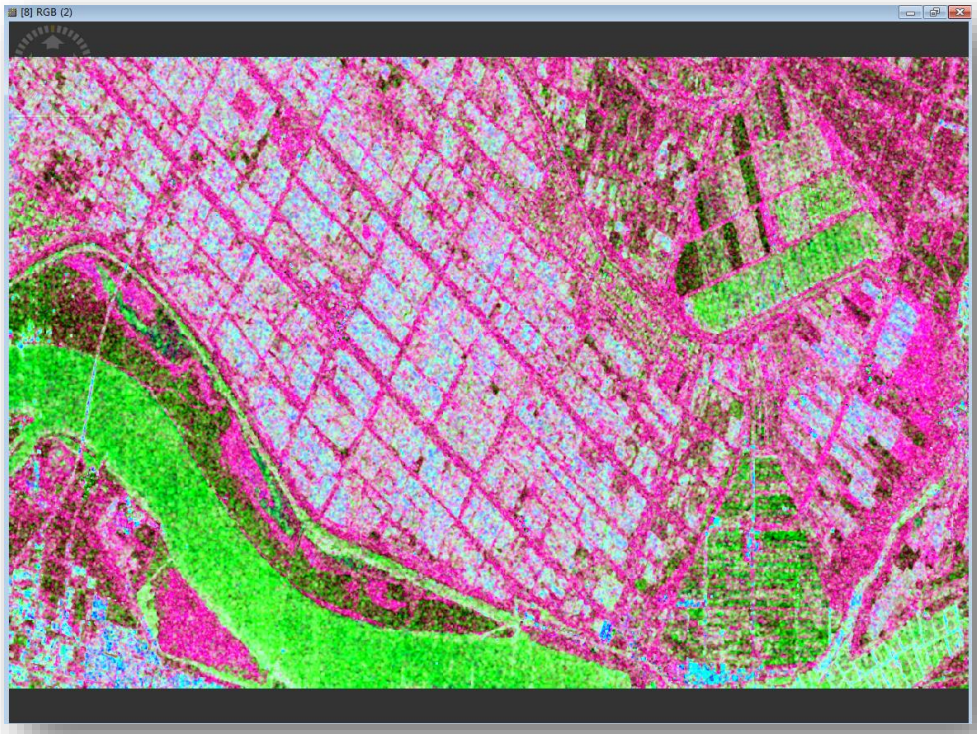

In the **Processing Parameters** tab, select the **Freeman-Durden Decomposition and H-A-Alpha decomposition, window size are both 5×5**. Press **Run** to begin processing.




When the processing completes, you can view all three bands in an RGB colour view by right-clicking on the product name and selecting **Open RGB Image View** from the popup menu.



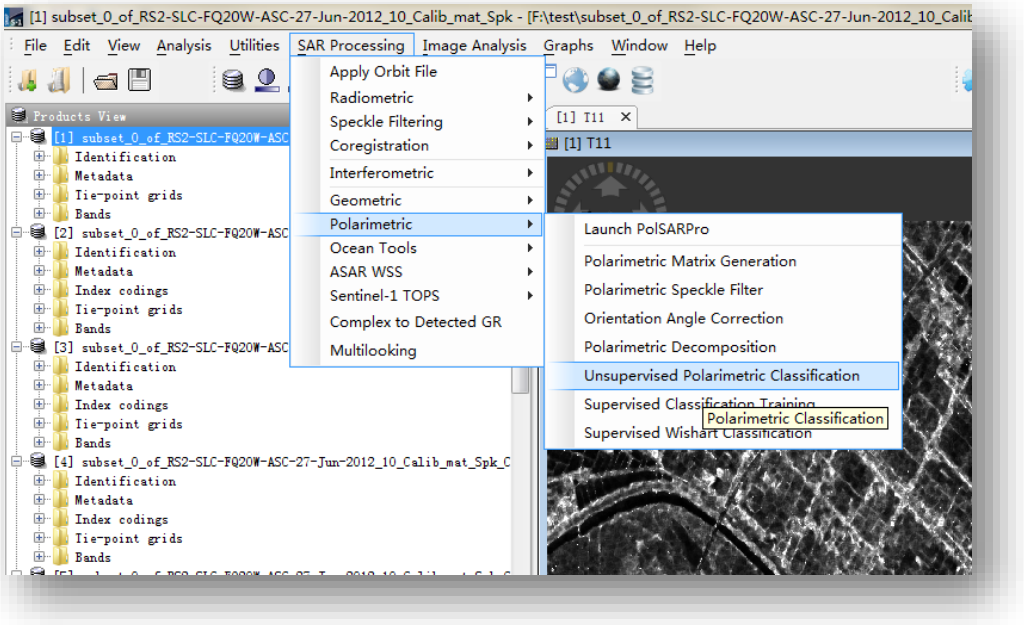

Freeman RGB（R=double bounce G=volume B=surface ）



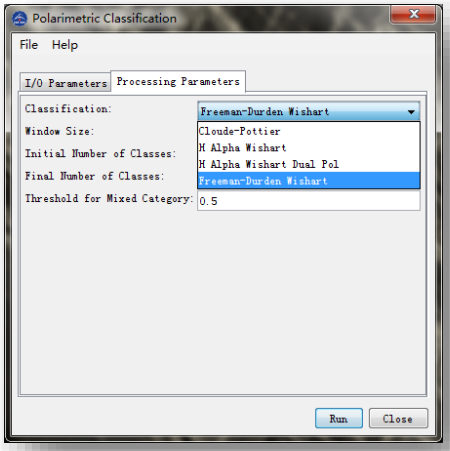

Cloude RGB (R=entropy G=Anisotropy B=alpha)

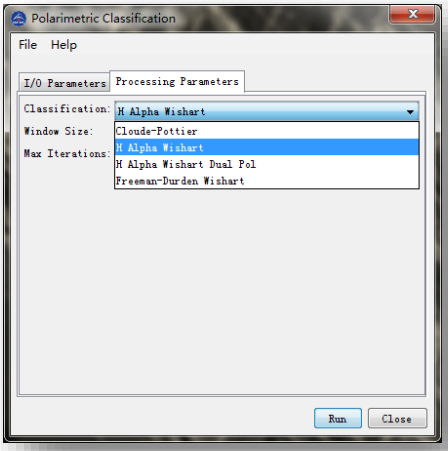
***Unsupervised polarimetric classification***

From the **SAR Processing** menu, go to the **Polarimetric** menu and select **Unsupervised polarimetric classification**.

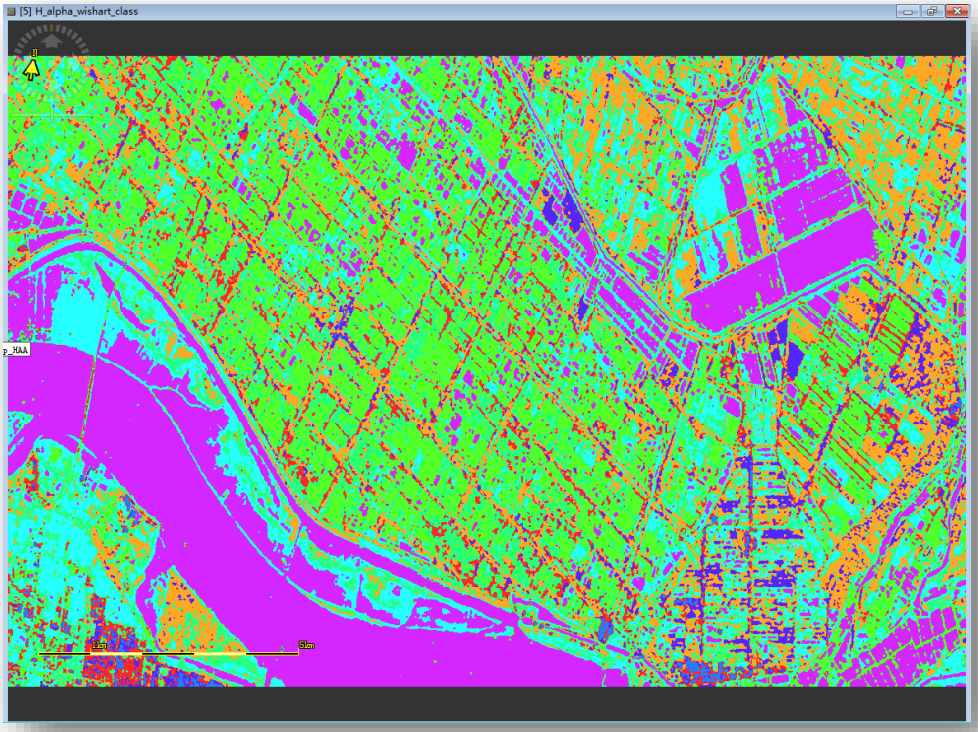



In the **Processing Parameters** tab, select the **H-Alpha Wishart and Freeman-Durden Wishart**. Press **Run** to begin processing.

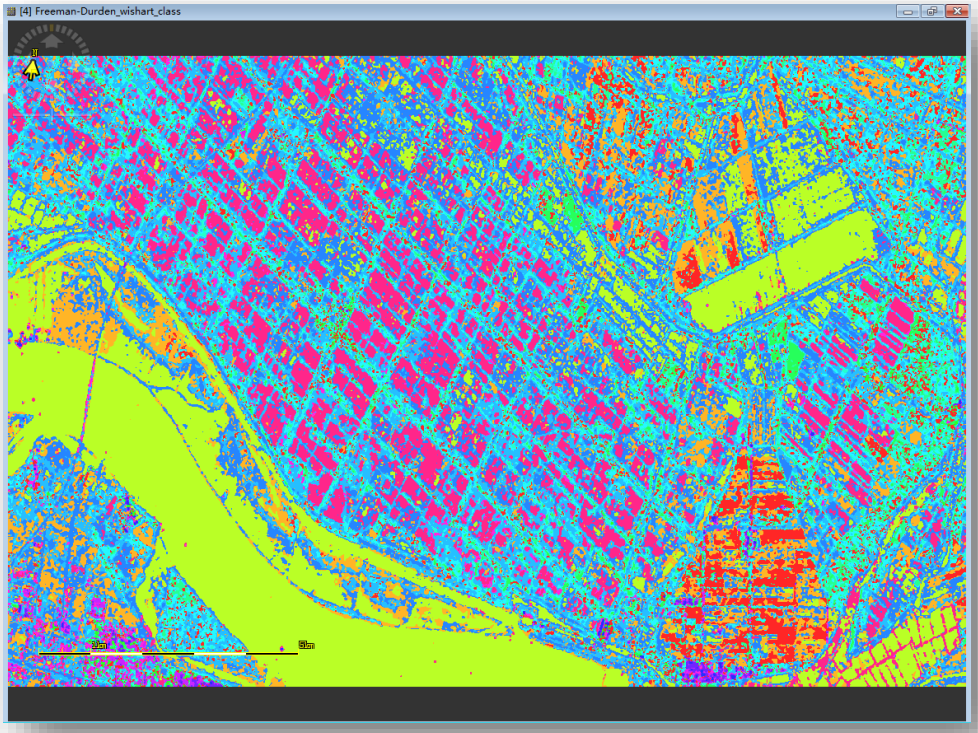



Double-click on the class results to open it.



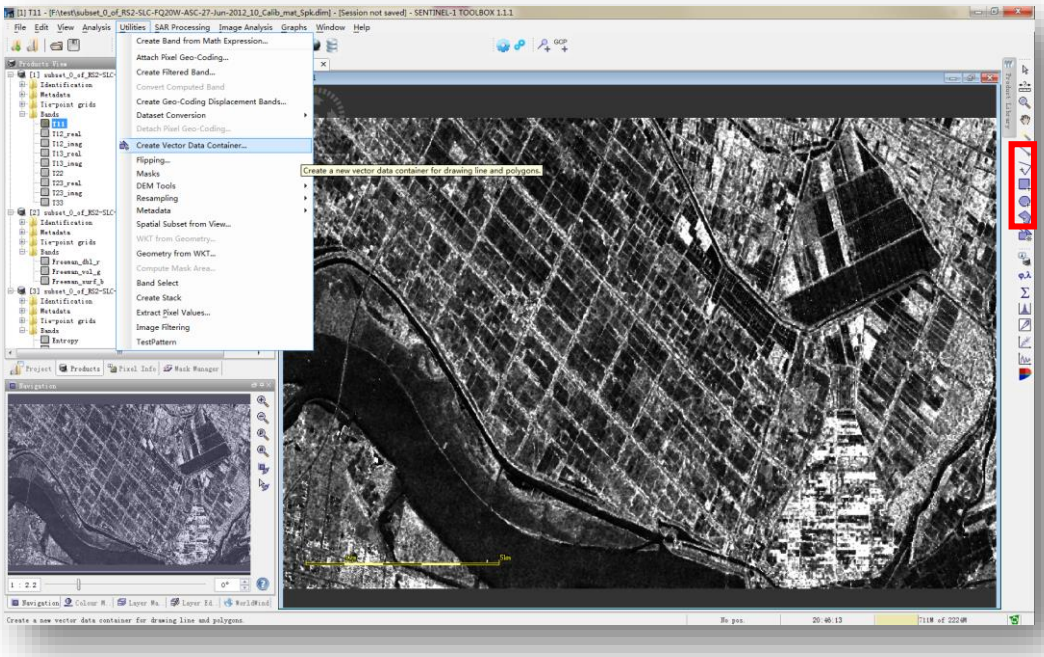

H-Alpha Wishart



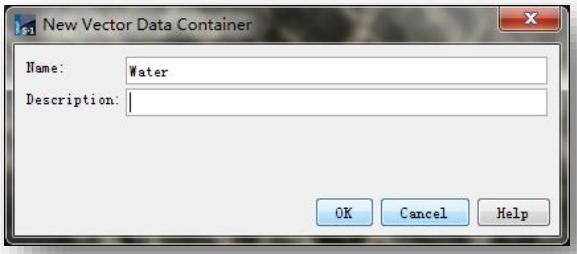

Freeman Wishart

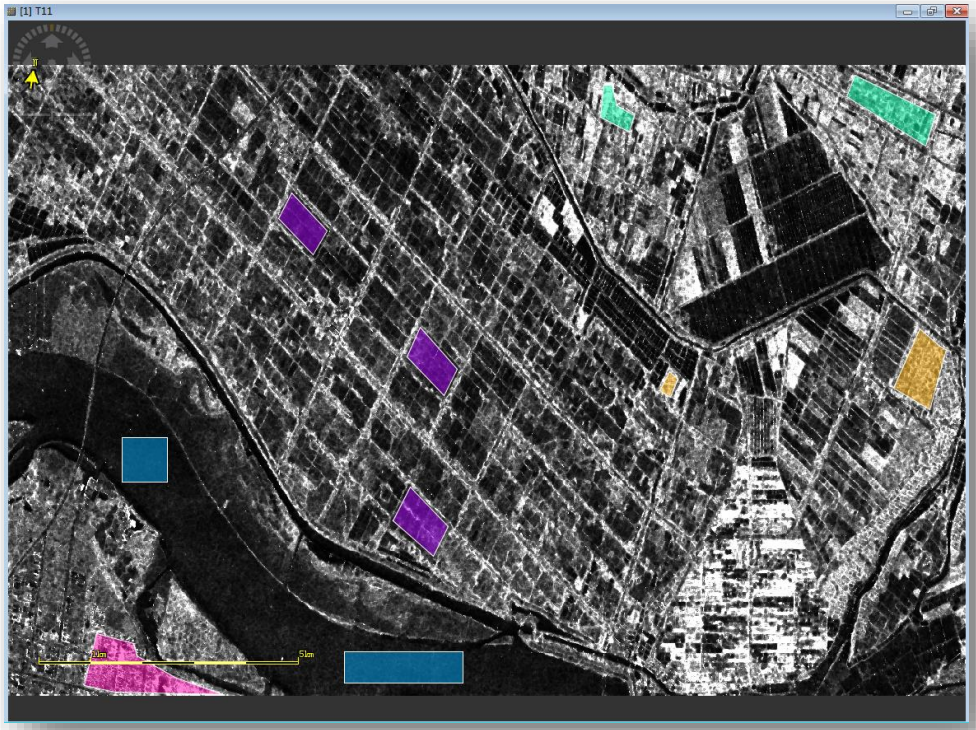
## *Supervised polarimetric classification*

Select areas as training data sets using the **Create a new geometry container** and other drawing tools on the right hand side of the tool box.

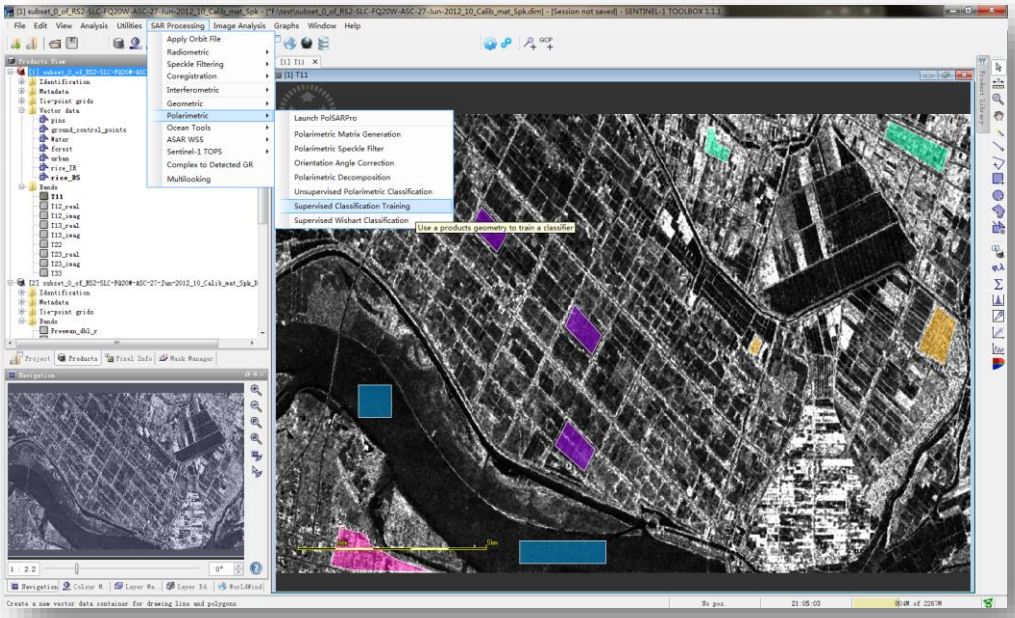


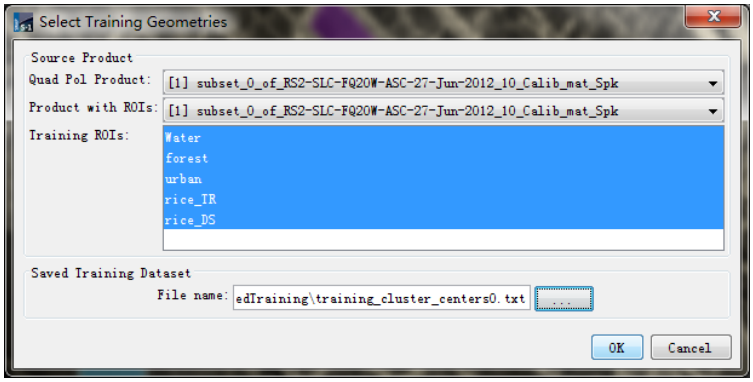

Create a new geometry container, name it and draw it in the image using the drawing tools.



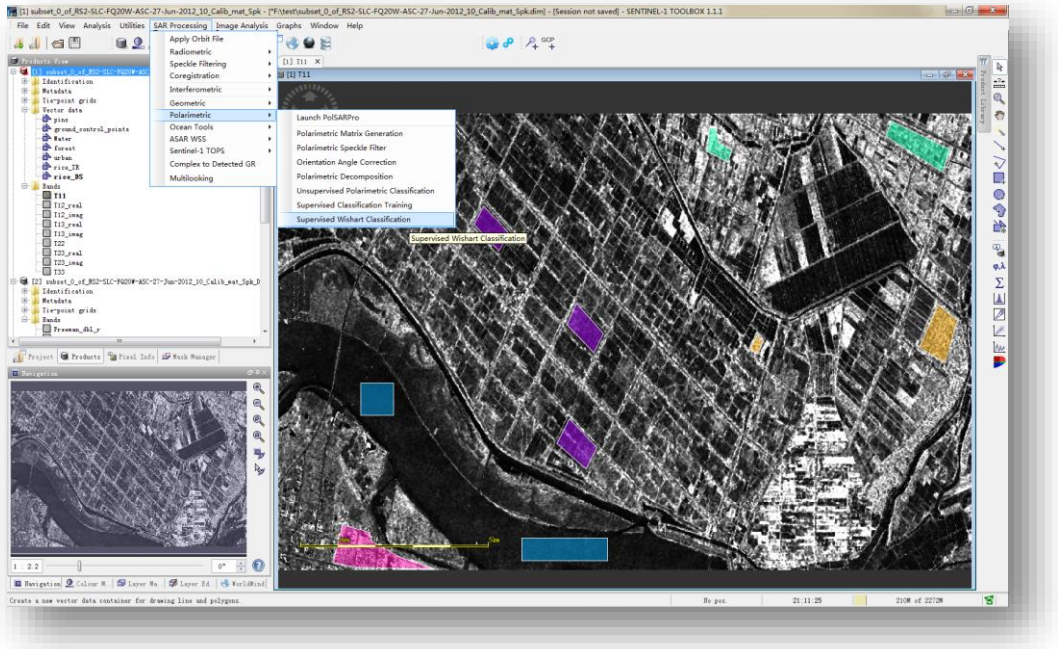



Select **Supervised Classification Training** from the **Polarimetric** menu, then highlight the training geometries and click on "OK" to start the training. The center for the coherency matrices of the pixels in each user identified class is computed and save in a text file in user specified directory.

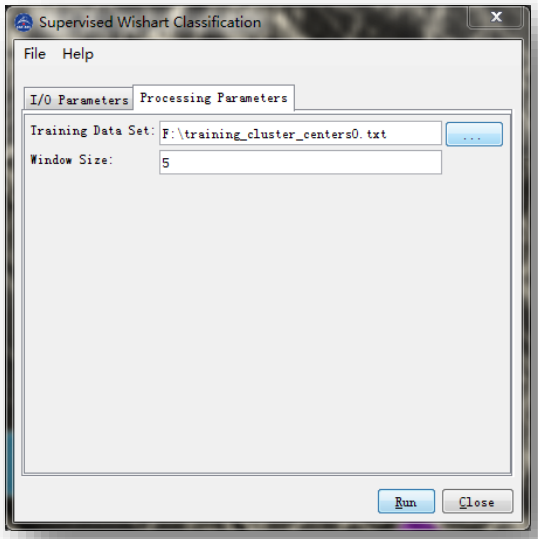


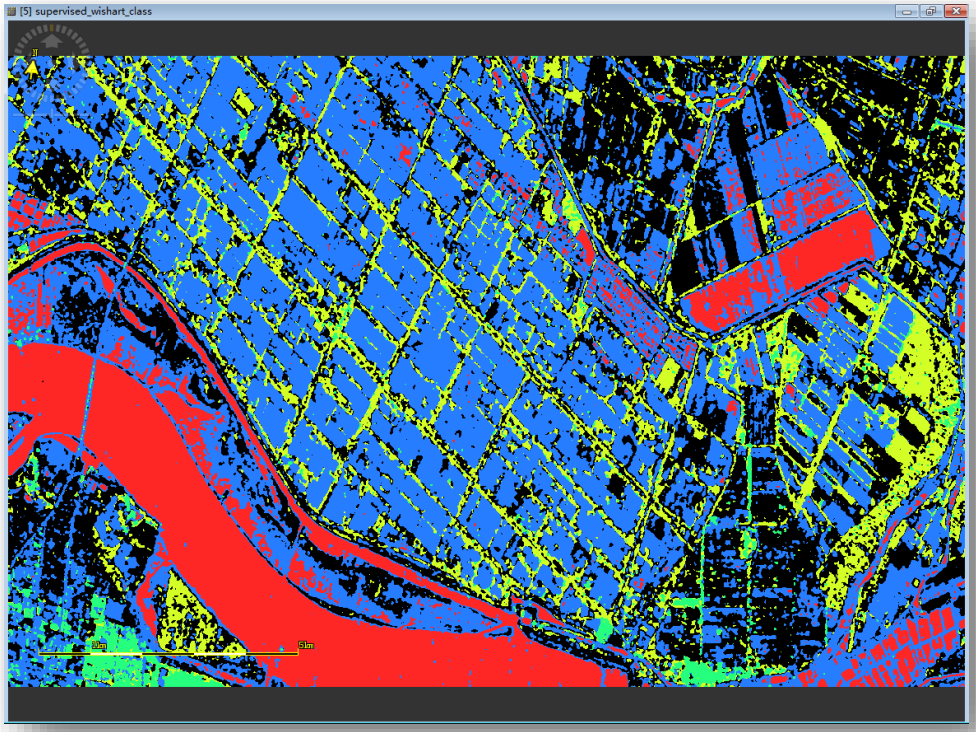



From the **SAR Processing** menu, go to the **Polarimetric** menu and select **Supervised Wishart Classification**.




In the **Processing Parameters** tab, select the training geometries txt file, window size 5×5. Press **Run** to begin processing.


Supervised Wishart Classification
File Help
I/O Parameters
Processing Parameters
Training Data Set:
F:\training_cluster_centers0.txt
...
Window Size:
5
Run
Close


[5] supervised_wishart_class
0km
5km

# Crops mapping with polarimetric SAR Data using GF-3 data

Objectives:

How to process GF-3 polarimetric products using PolSARpro 6.0

Polarimetric decompositions of GF-3 data for Crops identification

Crops mapping using unsuperivised polarimetric classification and supervised wishart classification

Data: The sample data used in this exercise was a subset from one GF-3 quad-pol image acquired on July 6, 2017

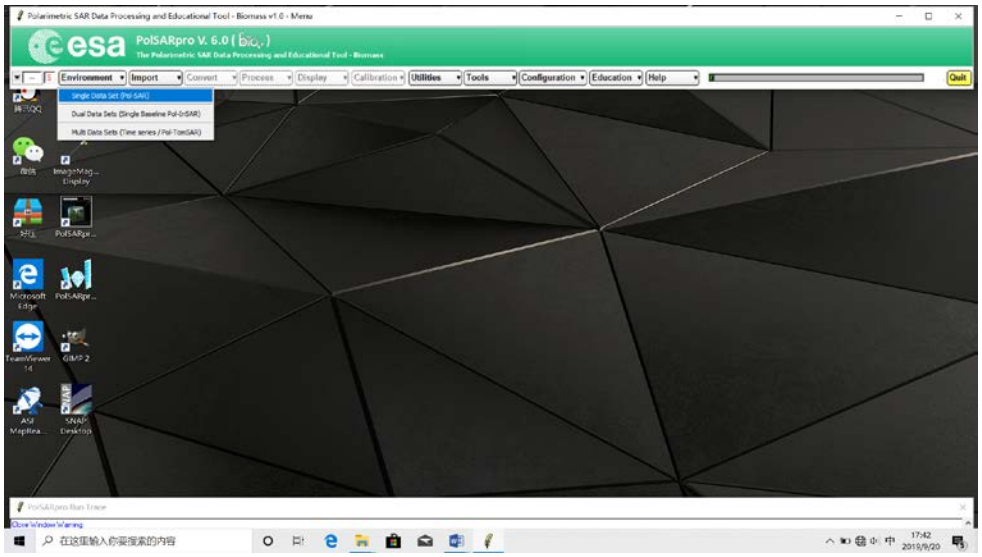
| | |
|---|---|
| Product | Single Look Complex (SLC) |
| Incidence angle mid swath | 41.18 |
| Nominal Resolution | 8 |
| Location | Guangxi, China |
| Center Frequency | 5.40 |

Software: PolSARpro 6.0

Tutorial:

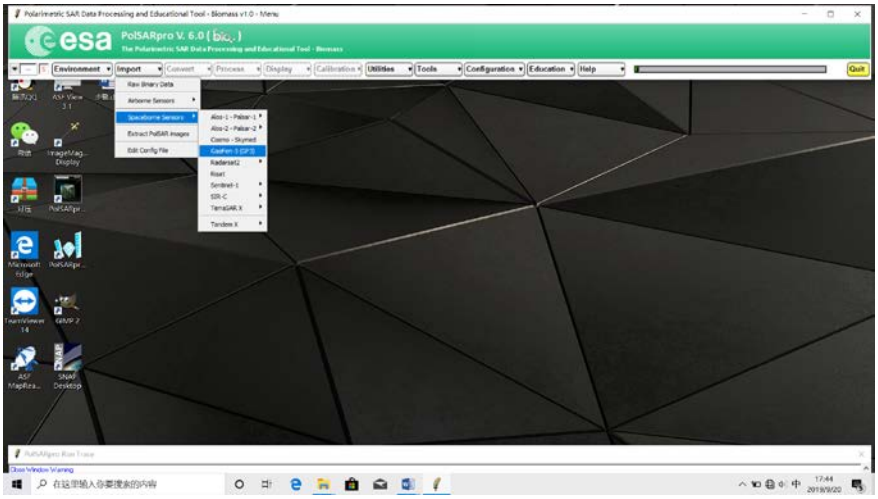
We choose the environment: Environment----Single Data Set (Pol-SAR), then choosing GF-3 data file folder.

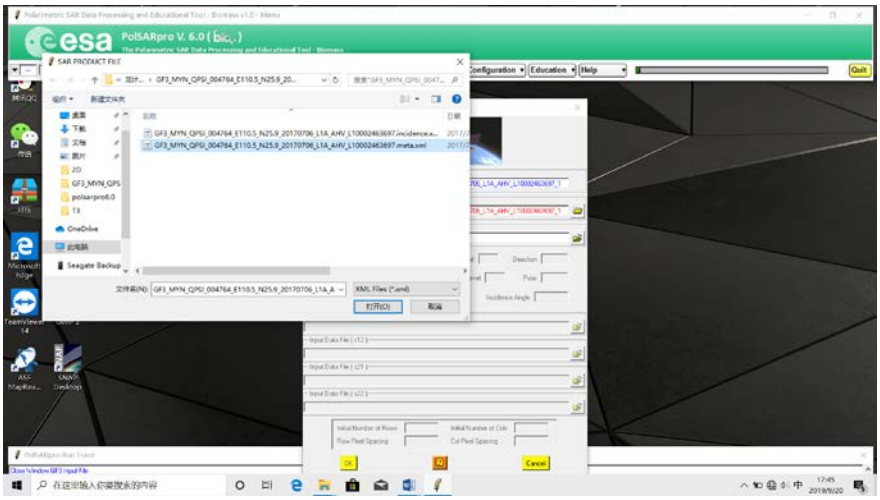
Selected and click “Save&Exit”，Will pop up one Warning：Choose “No”.

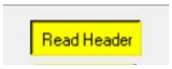


import data: import----Spaceborne Sensors----GaoFen-3(GF-3)

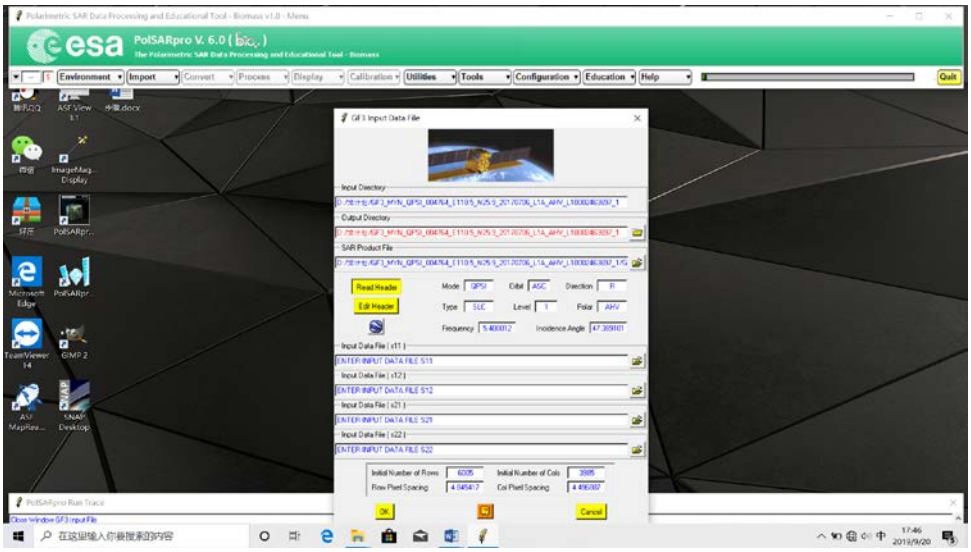
open file GF3_MYN_QPSI_004764_E110.5_N25.9_20170706_L1A_AHV_L10002463697.meta.xml

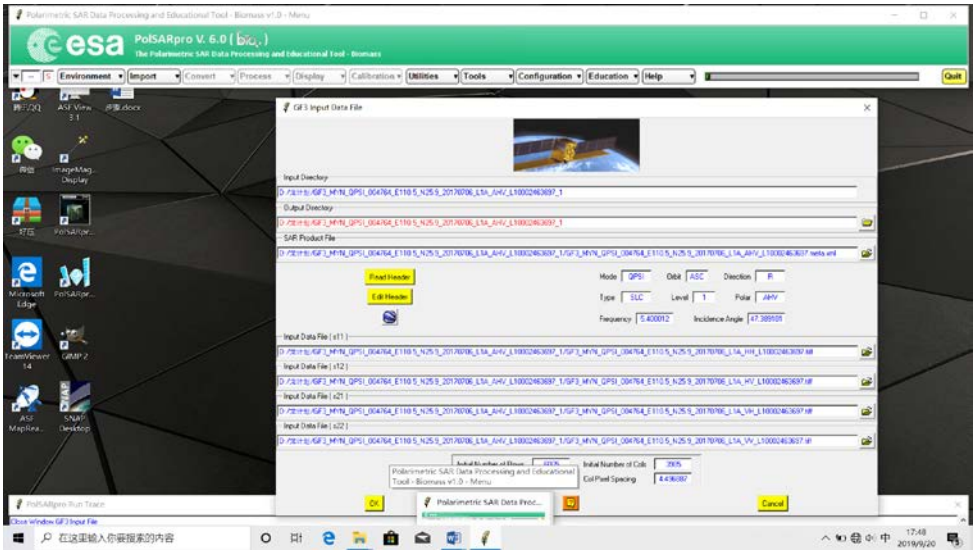


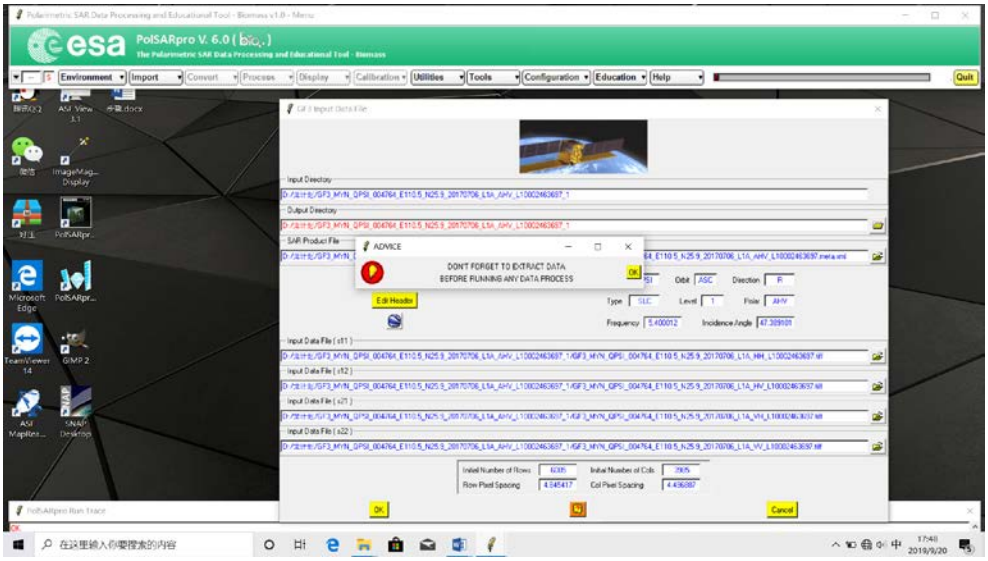


Read head file：Click 

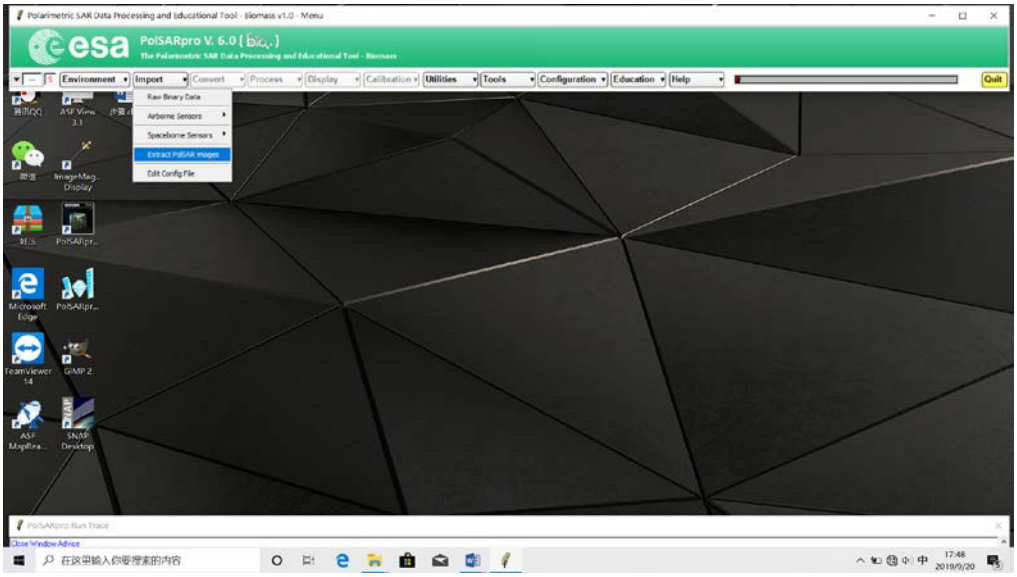

Import four polarizations S11\S12\S21\S22 corresponding to HH\HV\VH\VV

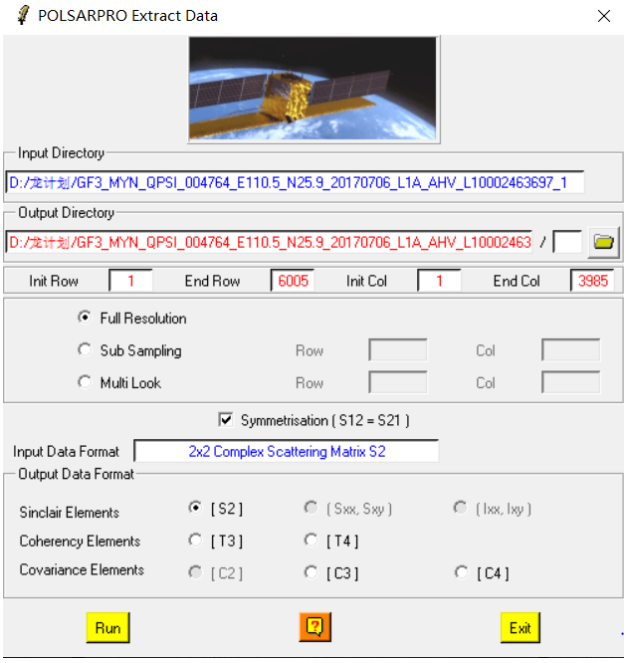




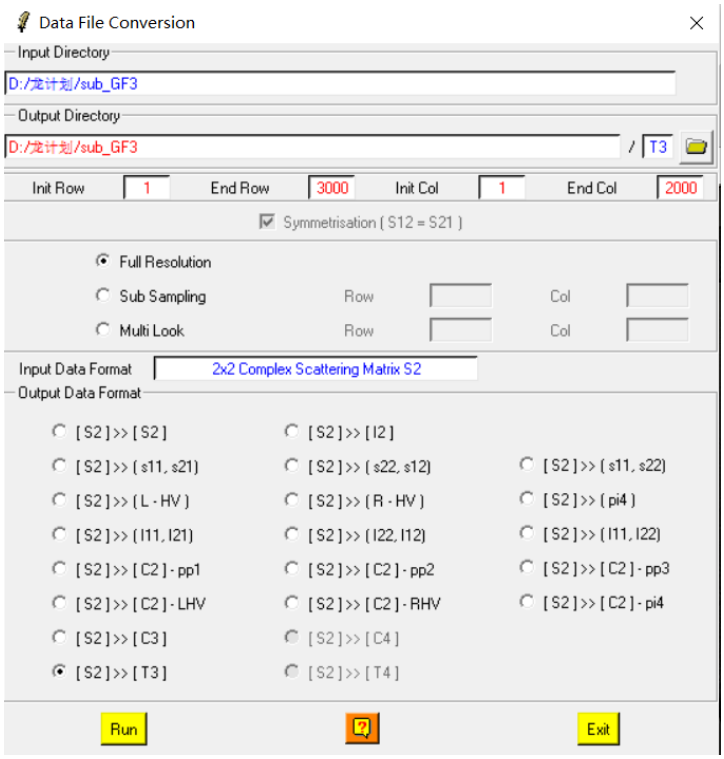


Extract PolSAR images, and choose Full Resolution. out data format Choose Sinclair Element.



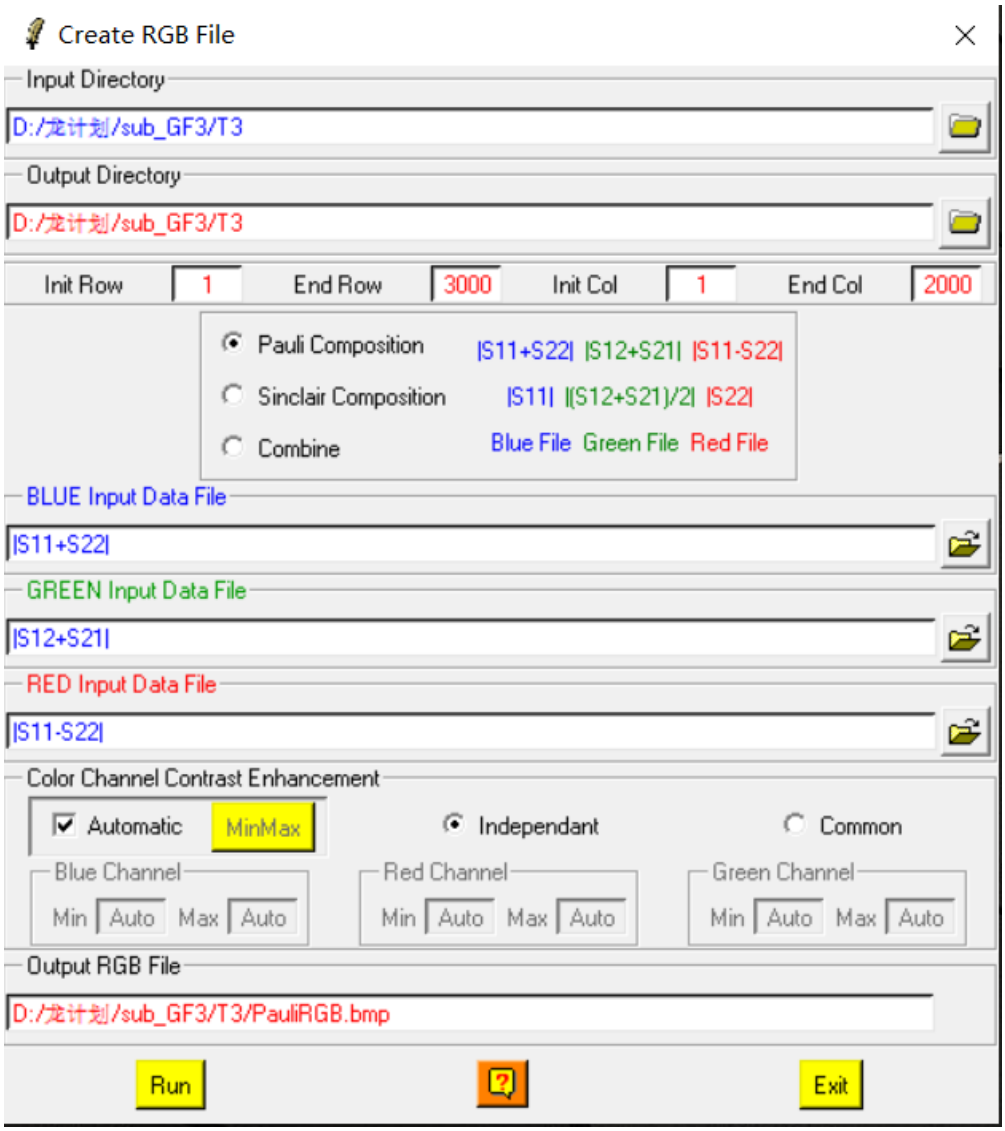




data conversion：Converting S2 to T3




Generate an RGB image for displaying a color composite image

Select：Display—>Create RGB File—>RGB Color Composition 1—>Run

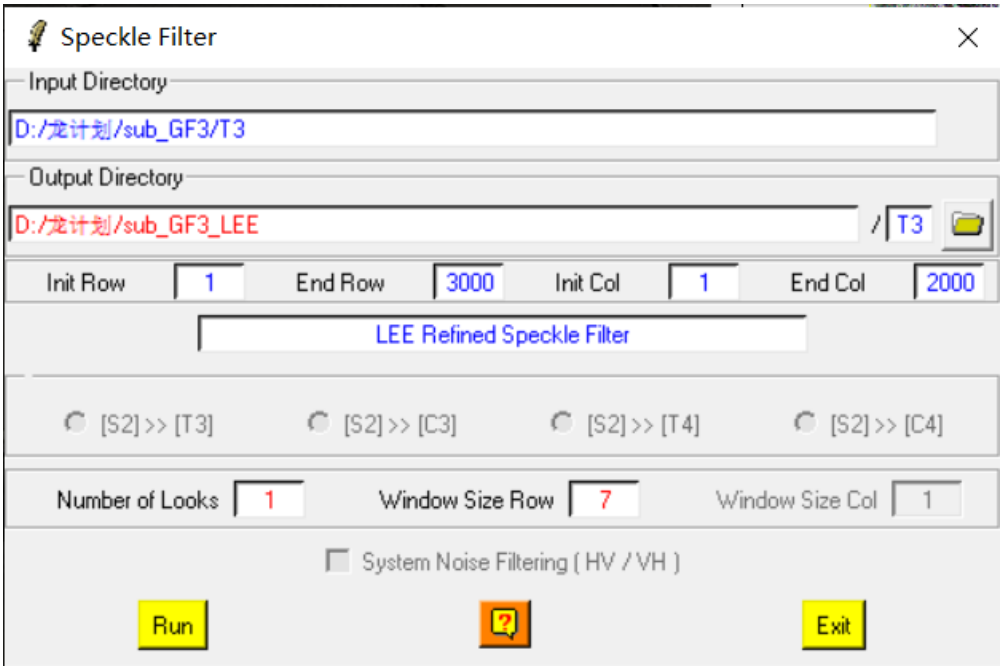



To clean up some of the speckle inherent in SAR images, you can apply a speckle filter. For full polarimetric data, speckle filters must take advantage of all bands and preserve the complex information.

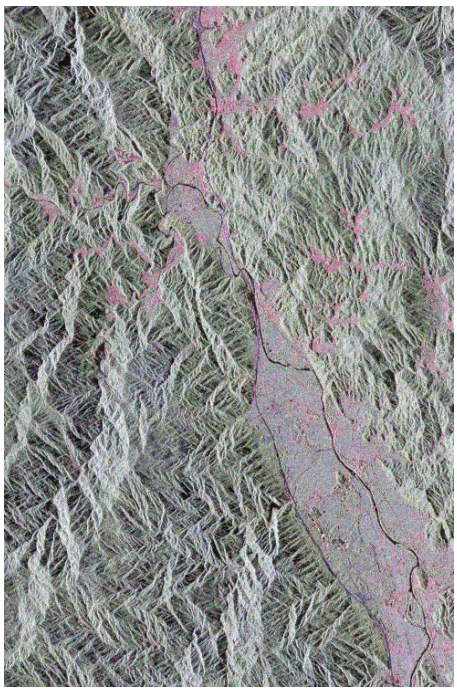
Next, the matrix T3 element is filtered.

Select：Process—>Polarimetric Speckle Filter—>Lee Refined Filter

Lee Refined Filter，the reason for choosing this filter is that it can retain the polarization information well under the influence of removing speckle filters.

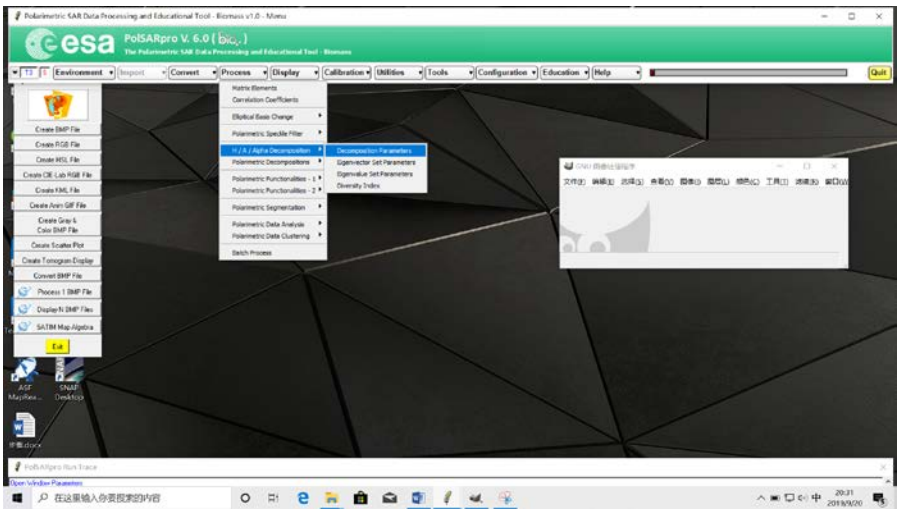


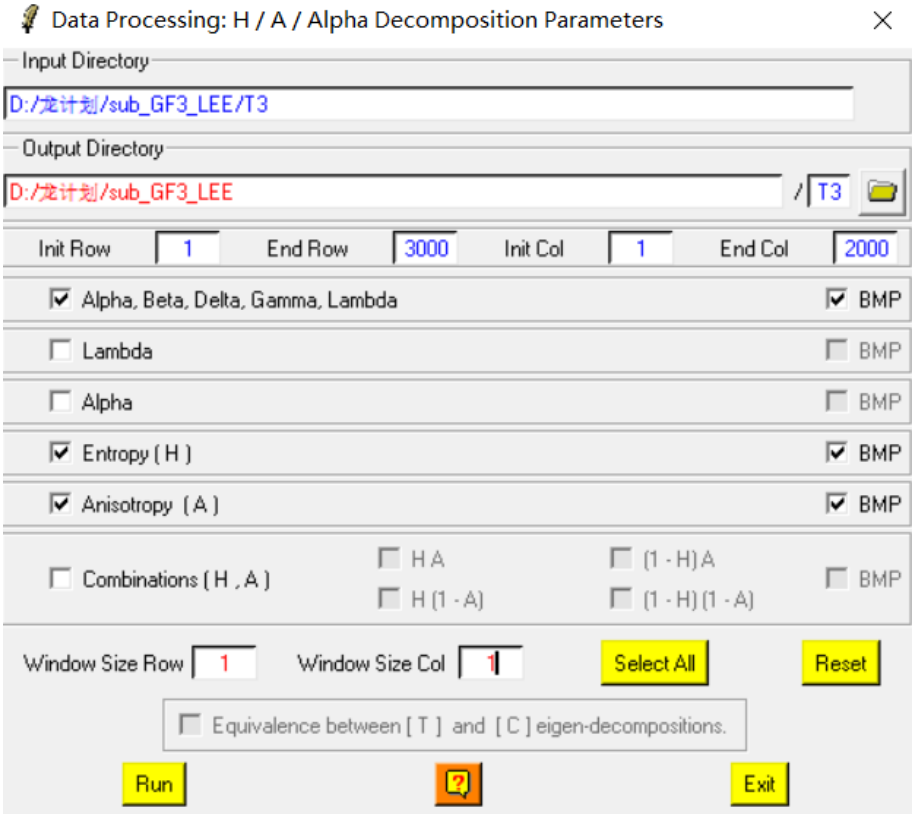

滤波前和滤波后的 RGB 合成图对比

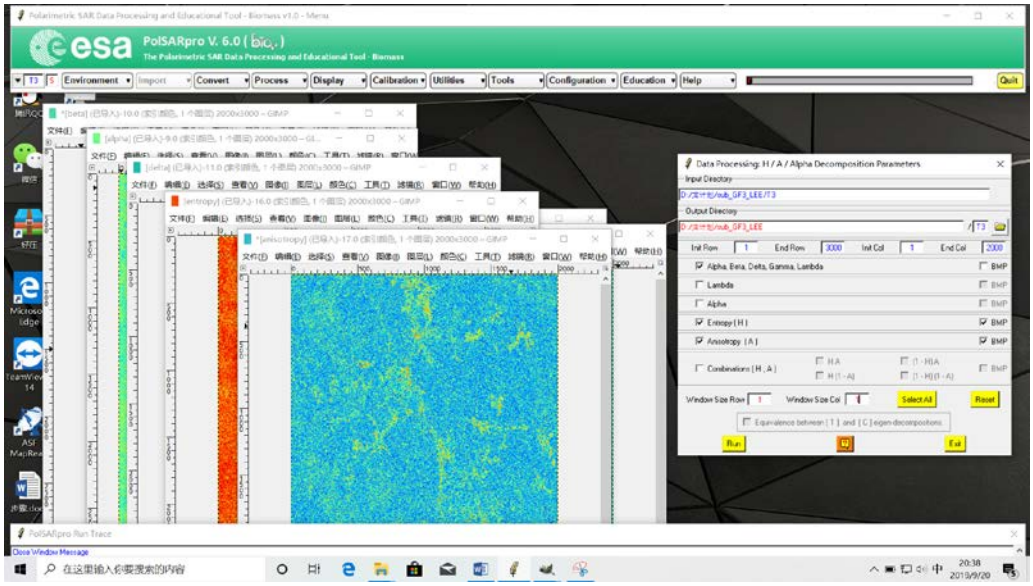


## Polarimetric Decompositions

Polarimetric decompositions allow the separation of different scattering contributions and can be used to extract information about the scattering process. From Process menu, elect Polarimetric Decomposition.
For example H/A/Alpha Polarimetric Decomposition

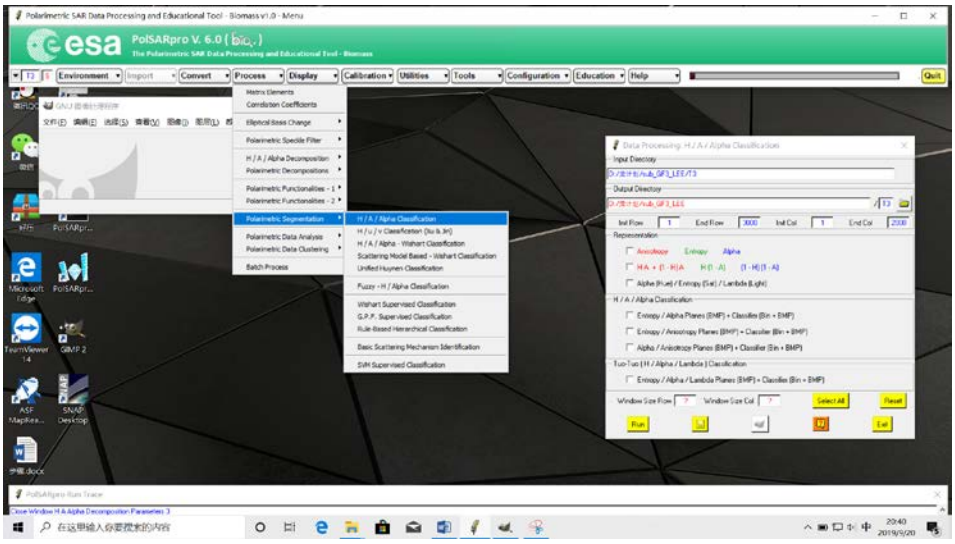


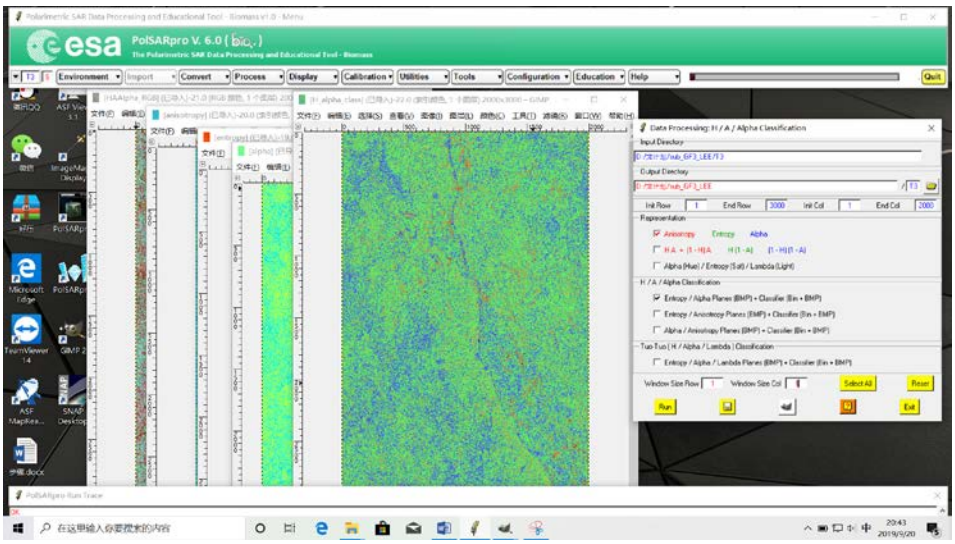




## Unsupervised polarimetric classification

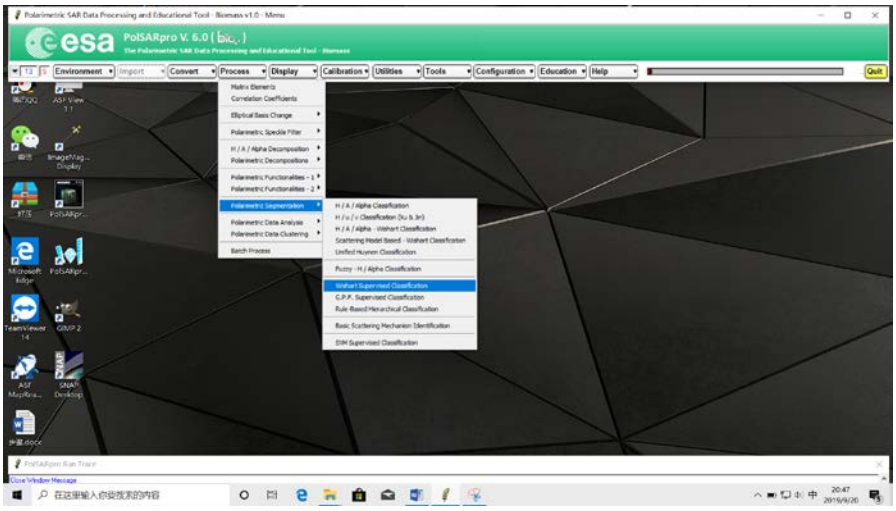
H/A/Alpha Classification:choose Process–>Polarimetric Segmentation—>H/A/Alpha Classification





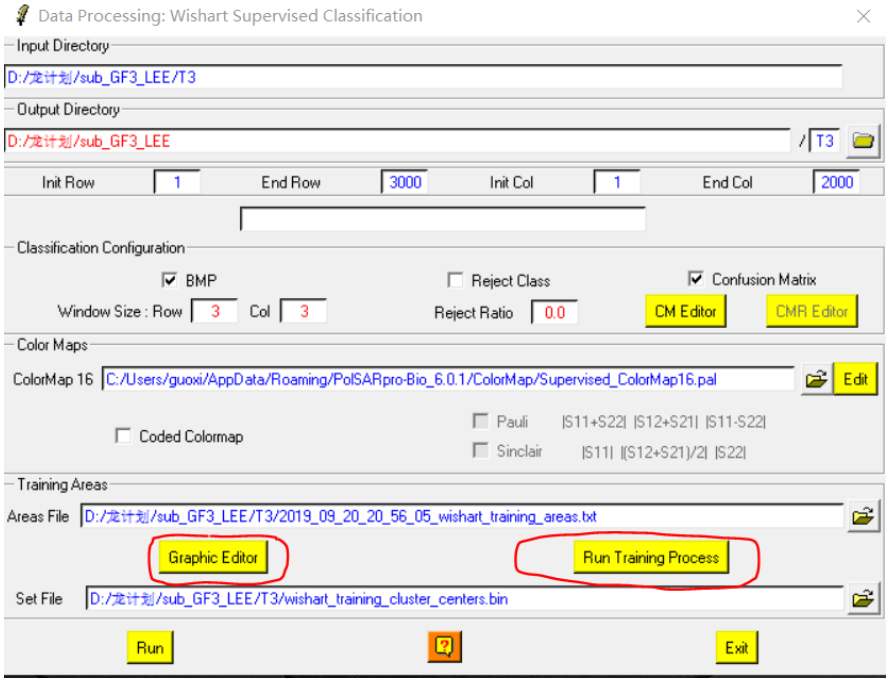
## Supervised polarimetric classification

In the supervised classification method, we choose Supervised Wishart Classification method for practice.



Click Graphic Editor, and you need to open a BMP file in order to make Classification Training.Then, you can edit Classification Training areas.This step is very important in supervised classification and will affect the final classification result. What's more, you click Run training process.

Five types of land objects were selected as follows:water, urban, forest, cropland and bamboo forest.


Data Processing: Wishart Supervised Classification
Input Directory
D:/龙计划/sub_GF3_LEE/T3
Output Directory
D:/龙计划/sub_GF3_LEE
/T3
Init Row
1
End Row
3000
Init Col
1
End Col
2000
Classification Configuration
BMP
Reject Class
Confusion Matrix
Window Size : Row
3
Col
3
Reject Ratio
0.0
CM Editor
CMR Editor
Color Maps
ColorMap 16
C:/Users/guoxi/AppData/Roaming/PolSARpro-Bio_6.0.1/ColorMap/Supervised_ColorMap16.pal
Edit
Coded Colormap
Pauli
|S11+S22| |S12+S21| |S11-S22|
Sinclair
|S11| |(S12+S21)/2| |S22|
Training Areas
Areas File
D:/龙计划/sub_GF3_LEE/T3/2019_09_20_20_56_05_wishart_training_areas.txt
Graphic Editor
Run Training Process
Set File
D:/龙计划/sub_GF3_LEE/T3/wishart_training_cluster_centers.bin
Run
Exit